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Hot runners can offer many benefits to manufacturers. But their use, placement and gating type should be considered early in the product development process to gain maximum advantage, says **André Eichhorn**

Tips for integrating hot runners

Hot runner technology has been with us for more than 40 years and while hot runners could be challenging to work with in the early days this is no longer the case – hot runner suppliers have made huge technical improvements over the past decade or so. That said, it remains the job of the component and mould designer to decide whether a hot runner system or gating style is appropriate for the specific task and, if so, to ensure the system is executed correctly.

The first point to consider is that not all moulding applications are suitable for hot runner technology. The volume of parts required each year is often the key driver as the cost of a hot runner system has to be justified. But sometimes it can be advantageous to have a cold runner attached to the component where post moulding operations such as painting or plating are required as it can simplify handling.

The typical principle advantages of using a hot runner system include:

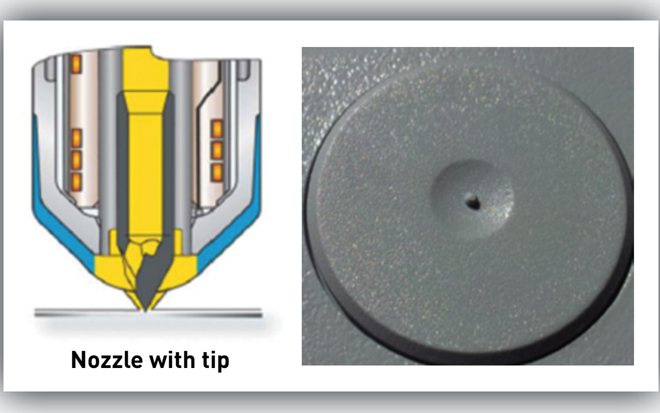
- material savings due to elimination of the cold runner;
- shorter cycle time;
- improved moulding system efficiency;
- better part quality;
- higher level of moulding automation;
- greater design flexibility;
- better balanced melt flow.

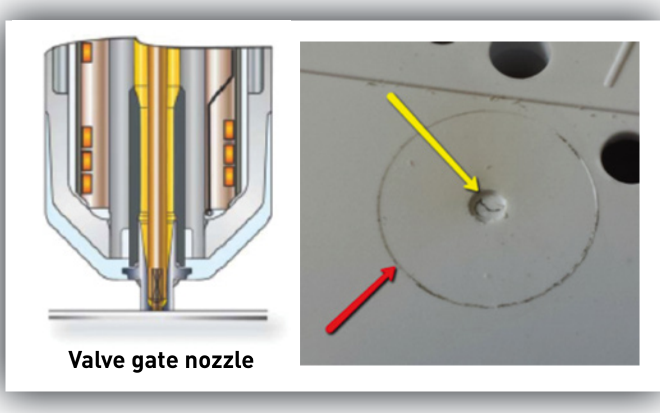
Once the decision has been made to incorporate a hot runner system into a mould, the question to be asked is: What kind of system is required? The hot runner suppliers themselves are the specialists in this regard and they have the most experienced people to help. So in general, the mouldmaker will place the design of the hot runner system in the hands of the supplier. What the hot runner designer will need in terms of information will include details of the component geometry, weight and material, and the pitch between the cavities. Normally the supplier will be provided with the complete tool design.

However, there are some key elements a product designer should consider during the DFM phase. The first is a commercial consideration - it does not make sense, for example, to work with a supplier that offers a good price and quality but has no service available in the area of the world where production will be carried out. After that, there are a number of major design aspects to consider.

Direct gate points are most often placed in areas where they are visible to the customer so the appearance of the gate point can be an issue, especially where the position is dictated by the need to achieve the best filling and packing of the component. There are two basic gating principles to consider: the open gate and the needle valve type.

The most common hot runner gate option is the open system, where the hot tip is placed on the component surface. This is the simplest option but the downside is





Above left: Figure 1: Visual appearance of an open nozzle

Above right: Figure 2: Visual appearance of a needle valve gate. The needle point is marked with a yellow arrow. The red arrow marks the nozzle tip witness line

that the feed point can be quite visible (Figure 1) and if the cooling performance of the tool is not optimised the gates can tend to string, especially on faster cycle times.

A needle valve system will give a more controlled gate point because the forward movement of the needle after injection and packing of the cavity allows the gate point to be closed positively. A needle valve system will also allow a slightly faster cycle time because it is possible to open the mould before or during the decompression phase of the moulding cycle. Figure 2 shows a typical needle valve gate, with the yellow arrow indicating where the needle has penetrated a little way into the component after the valve gate has closed (this recess can be adjusted in depth if and when needed). The red arrow marks the witness line of the nozzle tip, which guides the needle.

It is important to note that the steel around the gate point acts as both the guide and shut-off point for the needle. Depending on the hardness of the mould steel and the abrasiveness of the materials being processed – a glass reinforced PA being much worse in this respect than a PC/ABS blend, for instance – this area will wear. If the shut-off is machined directly into the cavity steel repairs can be time consuming and costly; it may be possible to make a welded repair but in the worst case a new cavity will be required. A better option is to place an easily-replaceable sub-insert in the nozzle tip area of the cavity.

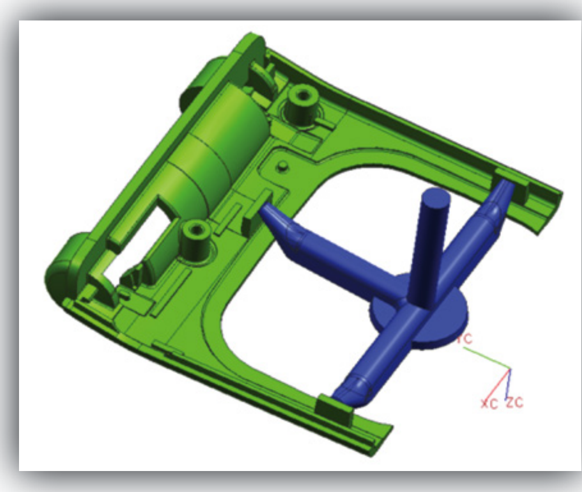


Figure 3: A disc placed in the centre of the cold runner allows a needle valve system to be guided using a standard nozzle tip

If the nozzle tip is placed onto a cold runner it is important to create a small disc in the system to avoid the nozzle tip making a steel shut-off with the core side, as the nozzle will grow in length due to thermal expansion (Figure 3).

While determining how many gate points will be needed and where they will be placed on the component, it is worth checking with the toolmaker or hot runner supplier on the minimum possible pitch between drops. This is especially important if you plan to use a valve gate system as the actuators that drive the needles are larger in diameter the nozzles.

The product designer should also take a look at any design features close to the anticipated direct gate point or points. Remember that the nozzle bores will be quite large compared to the typical gate point. A basic principle in tool design is that holes, for instance, will be inserted with core pins. If these pins need to be established on the cavity side they may interfere with the nozzle bore. This becomes an even bigger challenge when you have to cope with undercuts to be demoulded from the cavity side of the tool.

Hot runner tools are not rocket science and there are plenty of suppliers and systems available to suit even the most complicated applications. But fixing gate points in the early stage of the DFM phase is very important and it is useful for a component designer to have some insight into this tool technology before running into a problem as the design matures. Hot runner suppliers and manufacturers have plenty of expertise; it is good DFM practice to make use of it.

About the author:

André Eichhorn is general manager of Germany-based AST Technology. This is the latest instalment in a series of articles in which he discusses how part and moulding problems can be overcome at the start of any project by the application of Design for Manufacturing techniques. You can read the most recent articles in this series **here**, **here** and **here**.
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